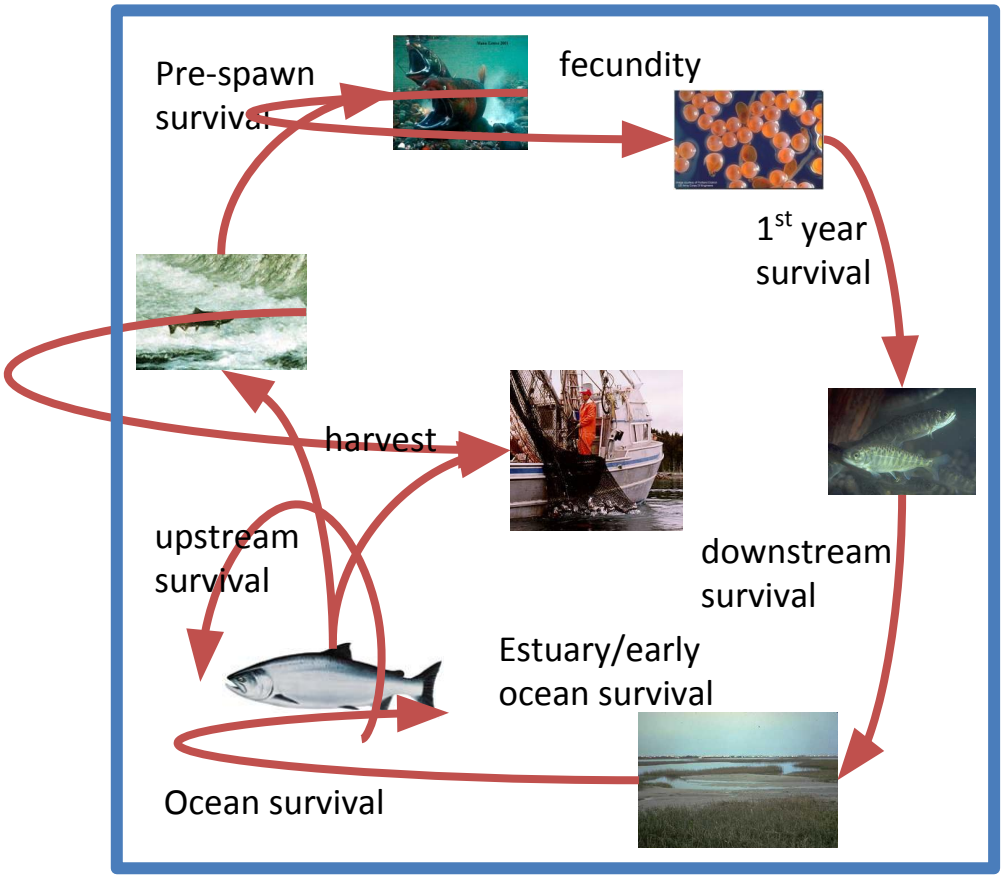
10.1 Life-Cycle Modeling of Columbia River Basin Salmonid Populations: Translating Mitigation Actions into Population Viability Metrics

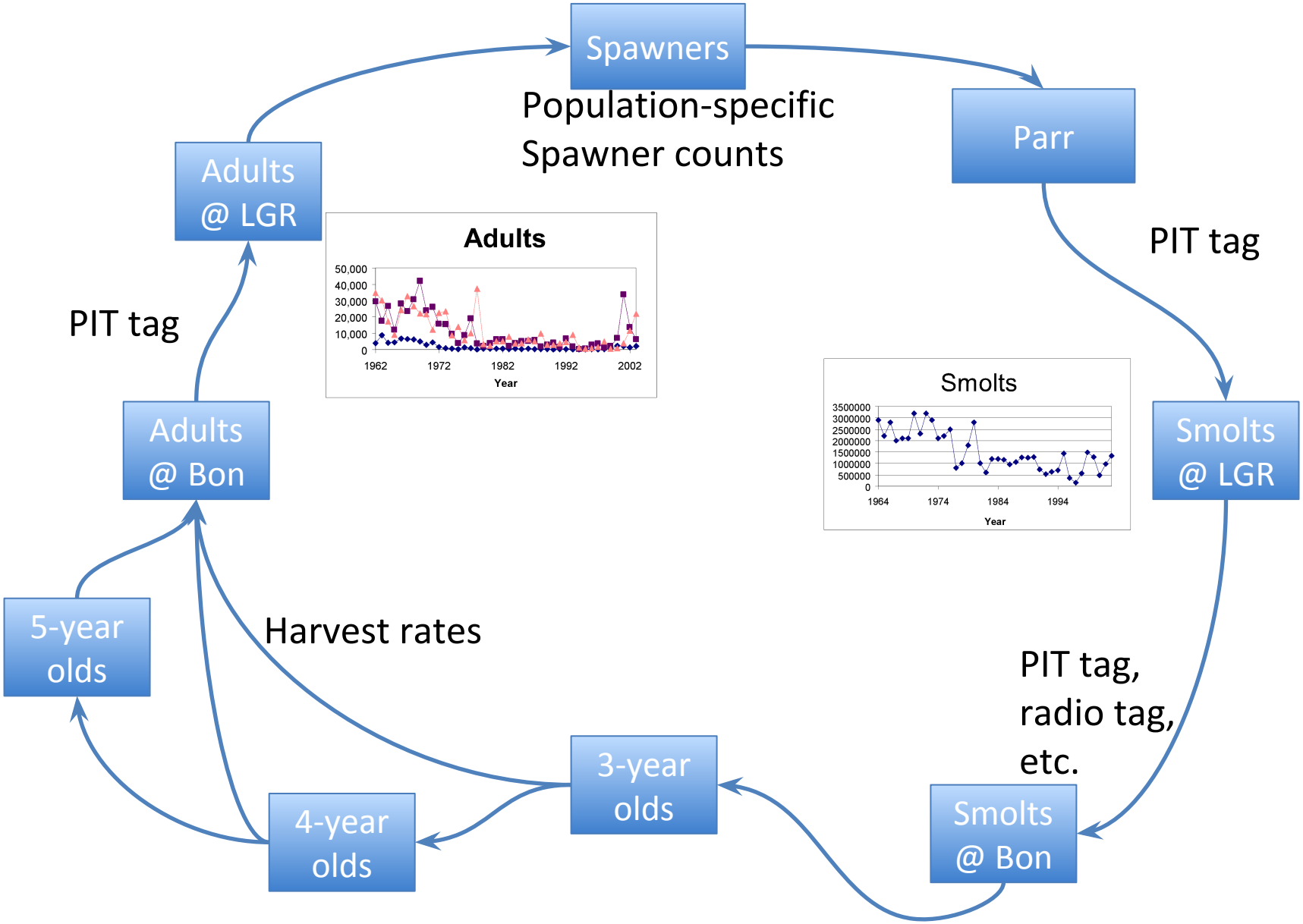


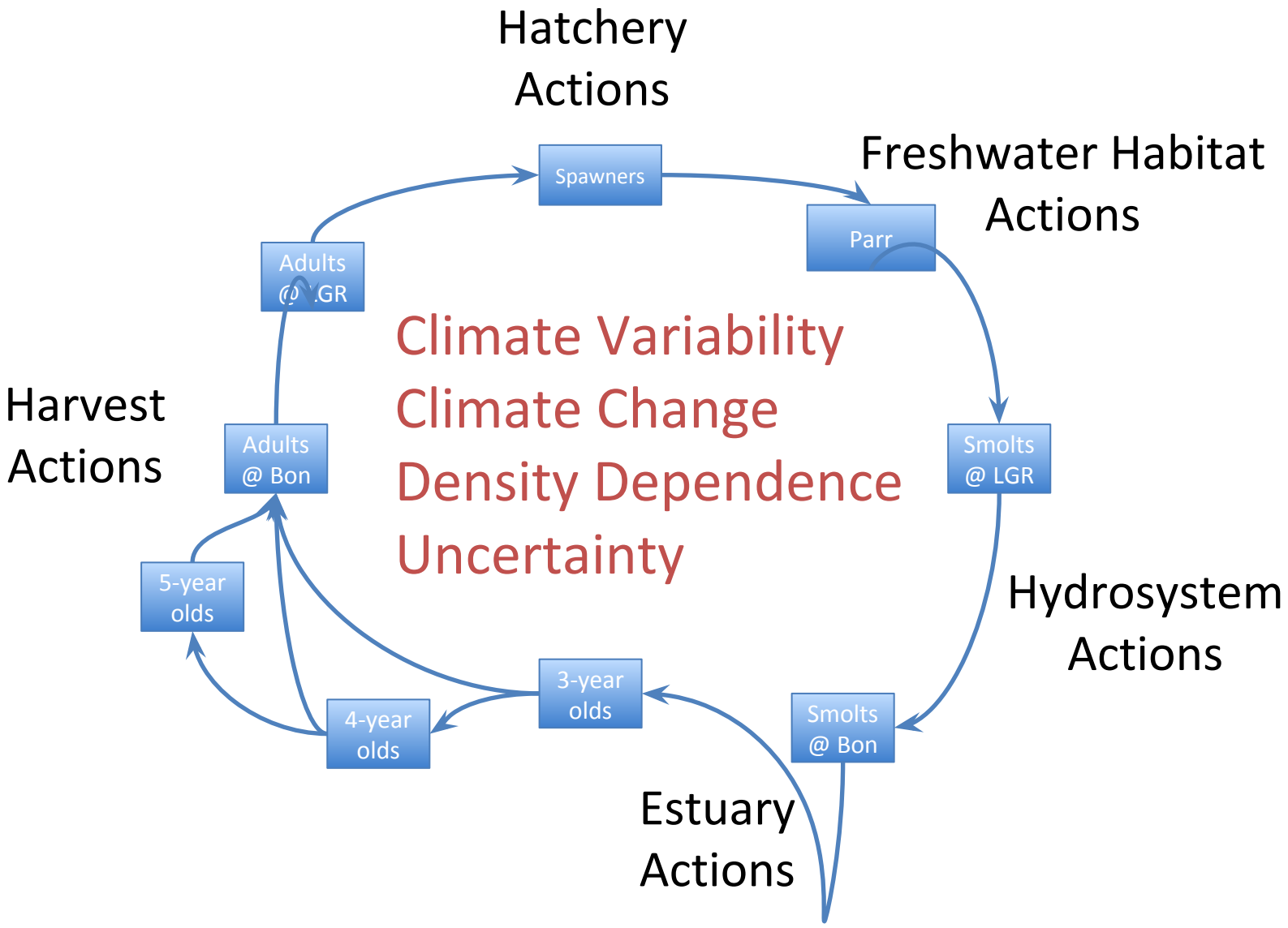
Richard Zabel

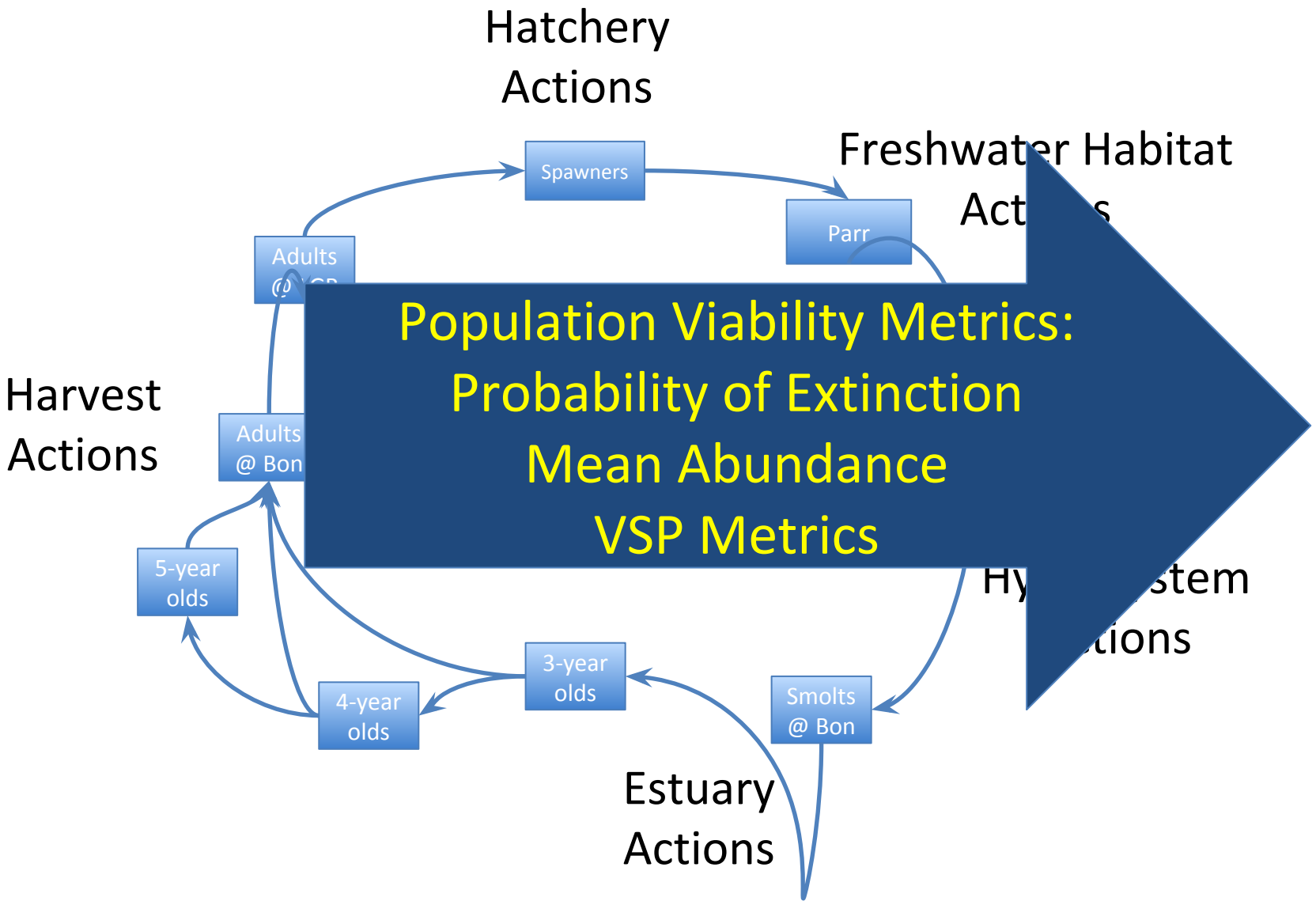
6 May 2015

Outline:

1) Background: Why Life Cycle Models?
2) Applications in the Interior Columbia
3) Applications in the Willamette River


Spawners
Population-specific
Spawner counts
Parr
PIT tag
Smolts
@ LGR
PIT tag,
radio tag,
etc.
Smolts
@ Bon
3-year
olds
4-year
olds
5-year
olds
Harvest rates
Adults
@ Bon
PIT tag
Adults
@ LGR
Adults
50,000
40,000
30,000
20,000
10,000
0
1962
1972
1982
1992
2002
Year
Smolts
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1964
1974
1984
1994
Year


Hatchery Actions
Freshwater Habitat Actions
Hydrosystem Actions
Estuary Actions
Harvest Actions
Spawners
Parr
Smolts @ LGR
Smolts @ Bon
3-year olds
4-year olds
5-year olds
Adults @ Bon
Adults @ LGR
Climate Variability
Climate Change
Density Dependence
Uncertainty


Hatchery Actions
Spawners
Parr
Adults @
Harvest Actions
Adults @ Bon
Population Viability Metrics:
Probability of Extinction
Mean Abundance
VSP Metrics
5-year olds
3-year olds
4-year olds
Smolts @ Bon
Estuary Actions

Recovery and Management Options for Spring/Summer Chinook Salmon in the Columbia River Basin

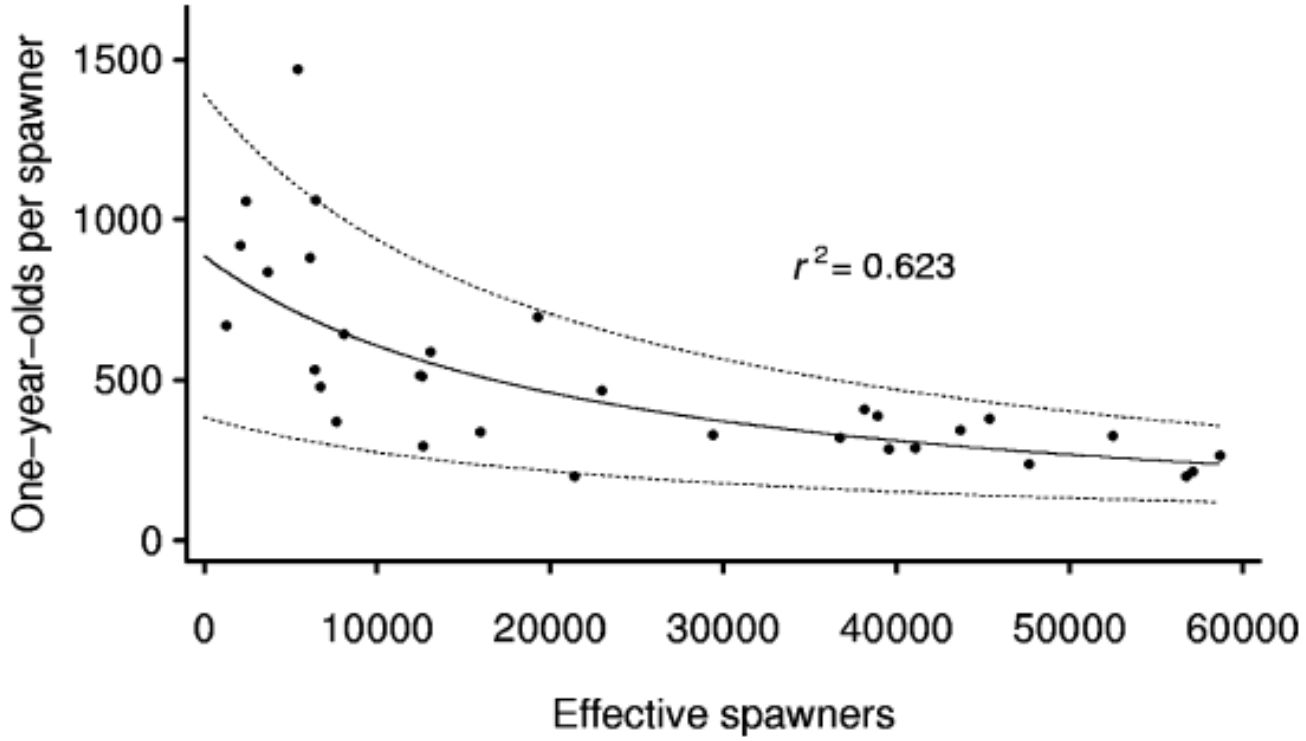
Peter Kareiva,[1] Michelle Marvier,[2] Michelle McClure[1]*

www.sciencemag.org SCIENCE VOL 290 3 NOVEMBER 2000

The Interplay between Climate Variability and Density Dependence in the Population Viability of Chinook Salmon

RICHARD W. ZABEL,* MARK D. SCHEUERELL, MICHELLE M. McCLURE, AND JOHN G. WILLIAMS
National Marine Fisheries Service, Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, WA 98112, U.S.A.

Conservation Biology Volume 20, No. 1, 190–200



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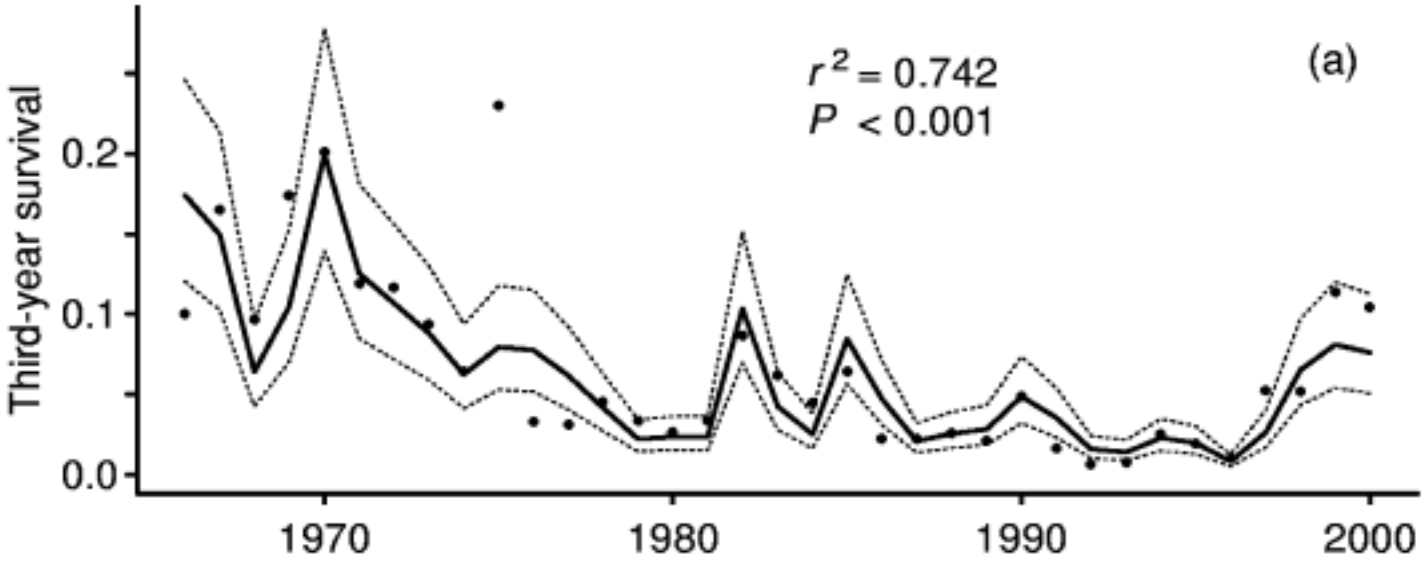


Assessing the Impact of Environmental Conditions and Hydropower on Population Productivity for Interior Columbia River Stream-type Chinook and Steelhead Populations

Interior Columbia Technical Recovery Team and R. W. Zabel

Adaptive Management Implementation Plan (AMIP)

New Areas of Focus:

- More Populations
- Effects of Habitat actions
- Link to monitoring activities
- Hatchery impacts on wild populations
- Spatial Patterns
- Complex life histories
  e.g. Snake R fall Chinook
  steelhead/rainbow

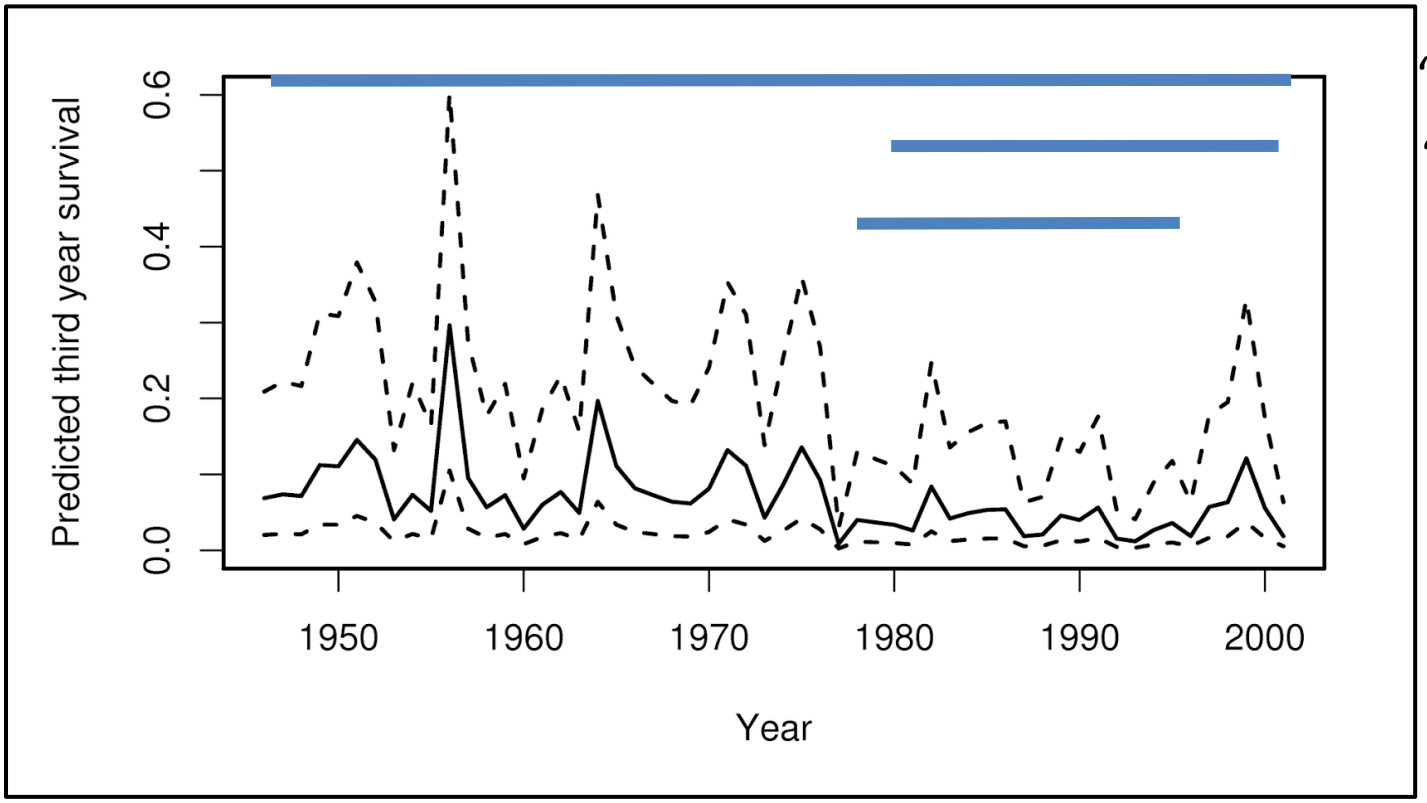
Life-Cycle models of salmonid populations in the interior Columbia River Basin

June 28, 2013

Collaborators:

NOAA Fisheries
ODFW
WDFW
IDFG
CRITFC
Nez Perce Tribe
Yakama Nation
USFWS
USGS
U of Idaho
U of Washington

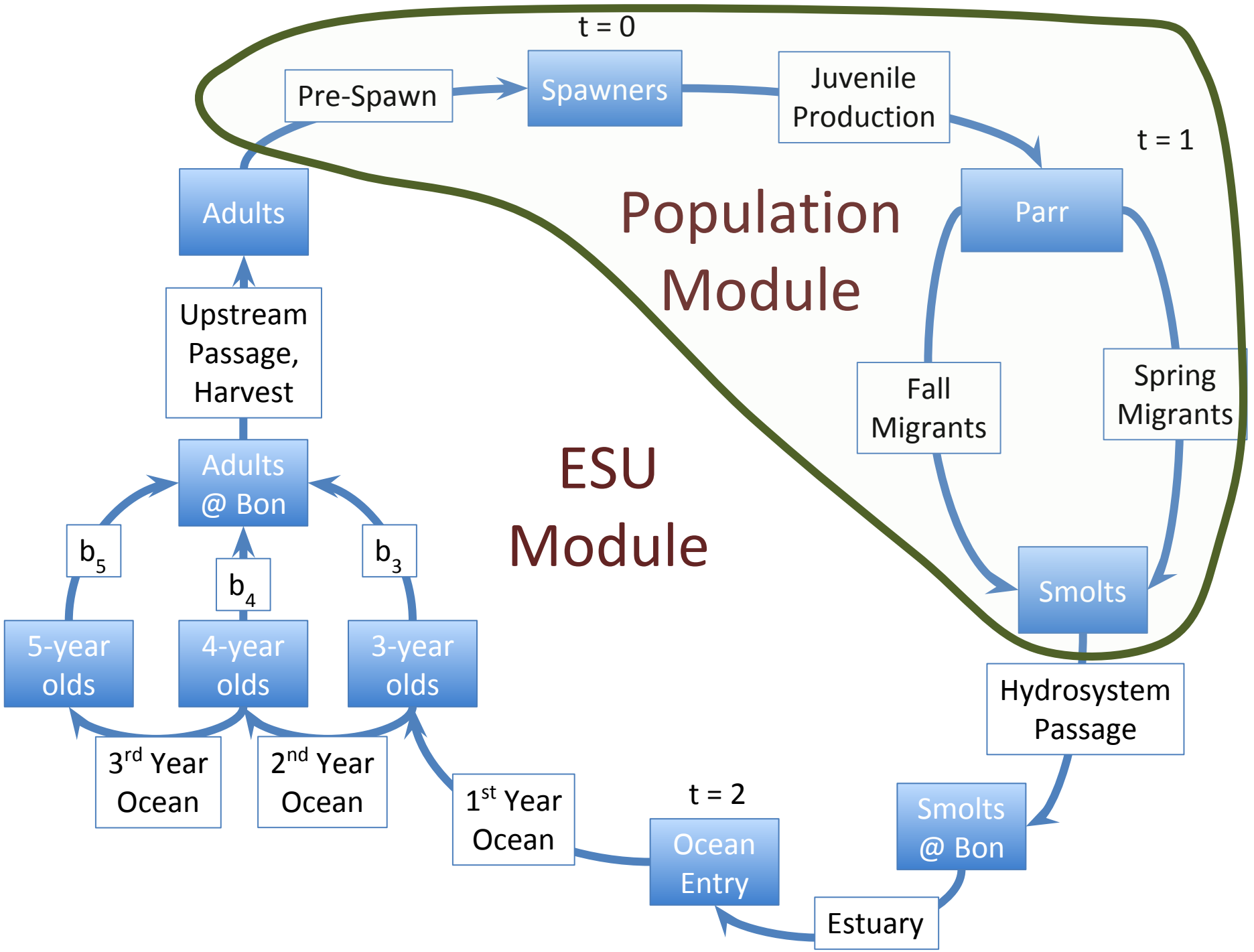
Future Climate Scenarios



"Historic"

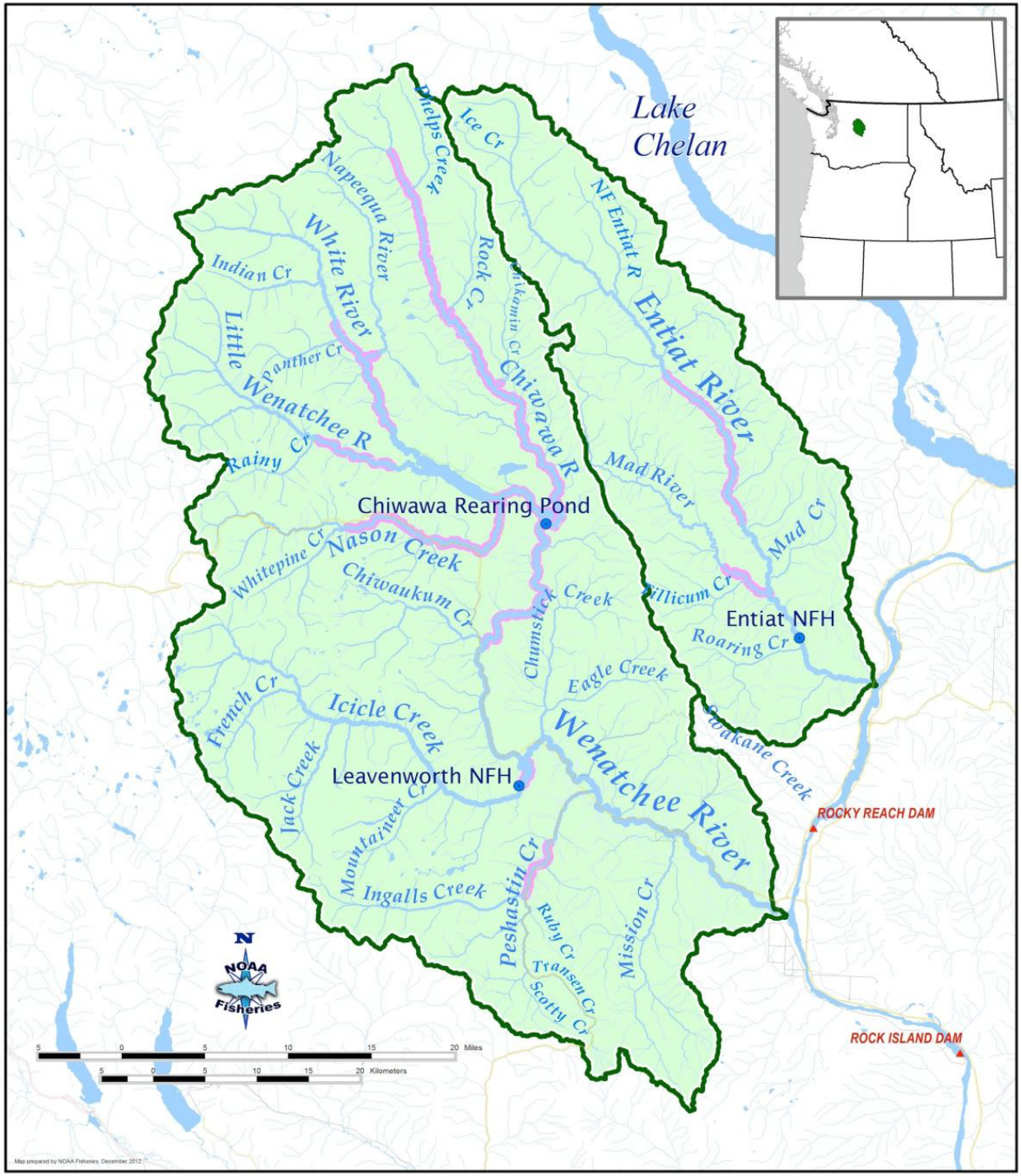
"Recent"

"Bad"


t = 0
Pre-Spawn
Spawners
Juvenile Production
t = 1
Adults
Population Module
Parr
Upstream Passage, Harvest
Fall Migrants
Spring Migrants
Adults @ Bon
ESU Module
b5
b4
b3
Smolts
5-year olds
4-year olds
3-year olds
Hydrosystem Passage
3rd Year Ocean
2nd Year Ocean
1st Year Ocean
t = 2
Smolts @ Bon
Ocean Entry
Estuary

2.3: Upper Columbia River spring Chinook salmon

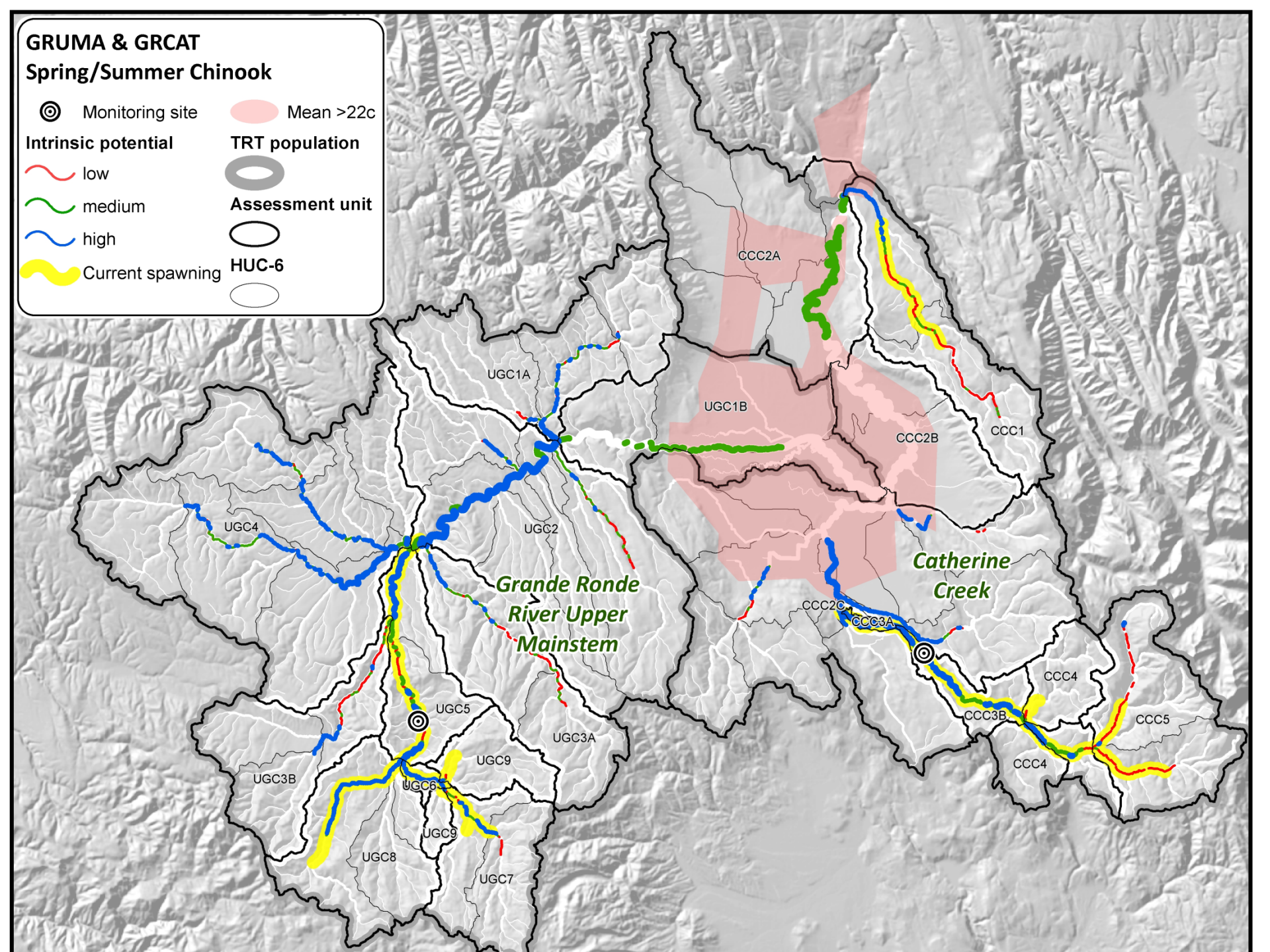
Jeff Jorgensen (NOAA Fisheries), Andrew Murdoch (WDFW), Jeremy Cram (WDFW), Charlie Paulsen (Paulsen Environmental Consulting), Tom Cooney (NOAA Fisheries), Rich Zabel (NOAA Fisheries), Chris Jordan (NOAA Fisheries)


Lake Chelan
Phelps Creek
Napeequa River
White River
Indian Cr
Little Wenatchee R
Panther Cr
Rainy Cr
Ice Cr
Rock Cr
Chikamin Cr
Chiwawa R
NF Entiat R
Entiat River
Mad River
Mud Cr
Chiwawa Rearing Pond
Whitepine Cr
Nason Creek
Chiwaukum Cr
Chumstick Creek
Tillicum Cr
Entiat NFH
Roaring Cr
Eagle Creek
French Cr
Icicle Creek
Leavenworth NFH
Jack Creek
Mountaineer Cr
Ingalls Creek
Peshastin Cr
Wenatchee River
Tsoukane Creek
ROCKY REACH DAM
Ruby Cr
Transen Cr
Scotty Cr
Mission Cr
ROCK ISLAND DAM
N
NOAA Fisheries
5 0 5 10 15 20 Miles
5 0 5 10 15 20 Kilometers
Map prepared by NOAA Fisheries, December 2012

Location	Actions
Upper Wenatchee River	Riparian plantings for bank stabilization, connection to floodplain and/or oxbows, large wood enhancement
Chiwawa River	Culvert replacements, brook trout control, nutrient additions
Nason Creek	Floodplain restoration (plantings), increase large wood complexes, side- & off-channel reconnections, improved fish passage, nutrient additions
Little Wenatchee River	Reduce fine sediments (riparian restoration), restore riparian/floodplain function (road decommissioning, riparian plantings), nutrient additions
White River	Riparian restoration, nutrient additions

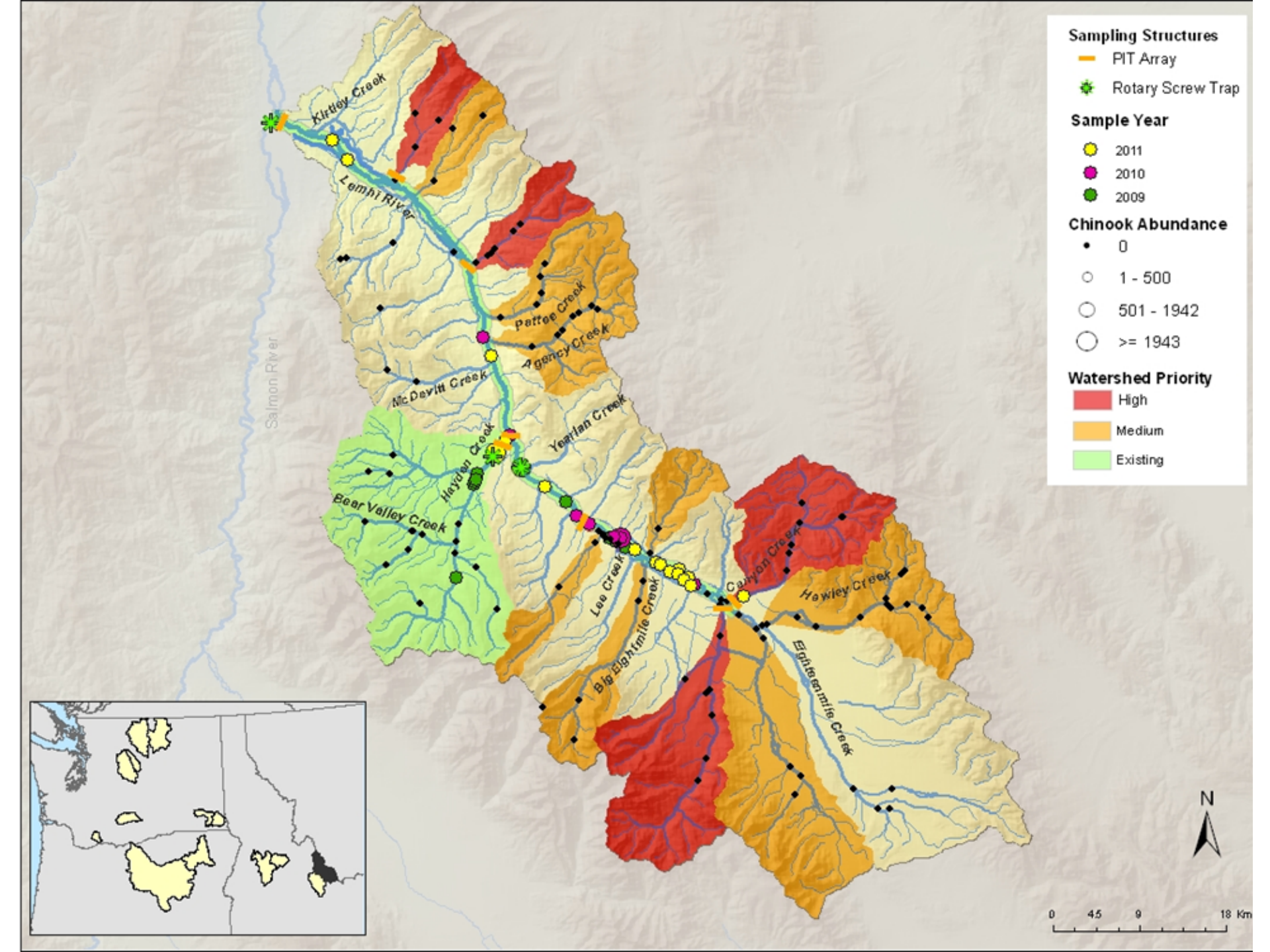
2.1: Grande Ronde Spring Chinook Population Models

Thomas D. Cooney (NWFSC), Richard W. Carmichael (ODFW), Brian C. Jonasson (ODFW), Edwin Sedell (ODFW) & Timothy L. Hoffnagle (ODFW)


GRUMA & GRCAT
Spring/Summer Chinook
Monitoring site
Mean >22c
Intrinsic potential
TRT population
low
medium
high
Current spawning
Assessment unit
HUC-6
CCC2A
UGC1A
UGC1B
CCC2B
CCC1
UGC4
UGC2
Grande Ronde
River Upper
Mainstem
Catherine
Creek
CCC2C
CCC3A
CCC4
CCC3B
CCC5
CCC4
UGC5
UGC3A
UGC9
UGC3B
UGC6
UGC9
UGC8
UGC7

2.2: Salmon Subbasin Integrated Status and Effectiveness Monitoring Project Watershed Model – Lemhi River

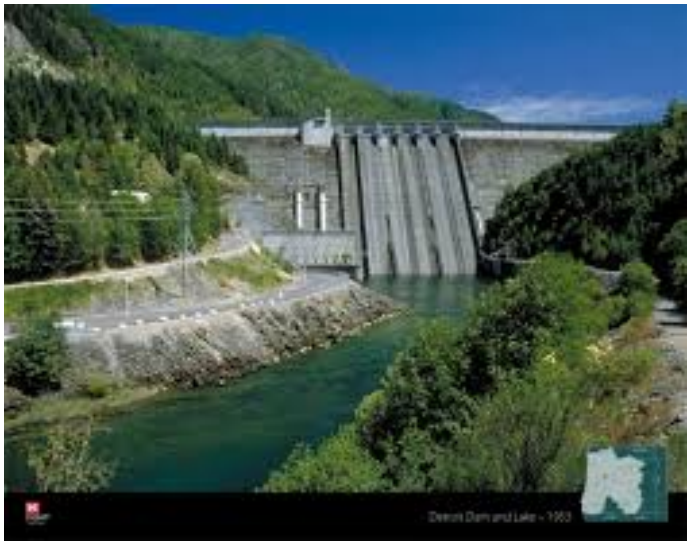
Chris Beasley (Quantitative Consultants, Inc.), Jody White (Quantitative Consultants, Inc.), Chris Jordan (NOAA Fisheries), Matt Nahorniak (South Fork Research, Inc.)


Sampling Structures
PIT Array
Rotary Screw Trap
Sample Year
2011
2010
2009
Chinook Abundance
0
1 - 500
501 - 1942
>= 1943
Watershed Priority
High
Medium
Existing
Kirtley Creek
Lemhi River
Salmon River
Pattee Creek
Agency Creek
McDevitt Creek
Hayden Creek
Bear Valley Creek
Yearian Creek
Lee Creek
Big Eightmile Creek
Canyon Creek
Hawley Creek
Eightmile Creek
N
0
4.5
9
18 Km

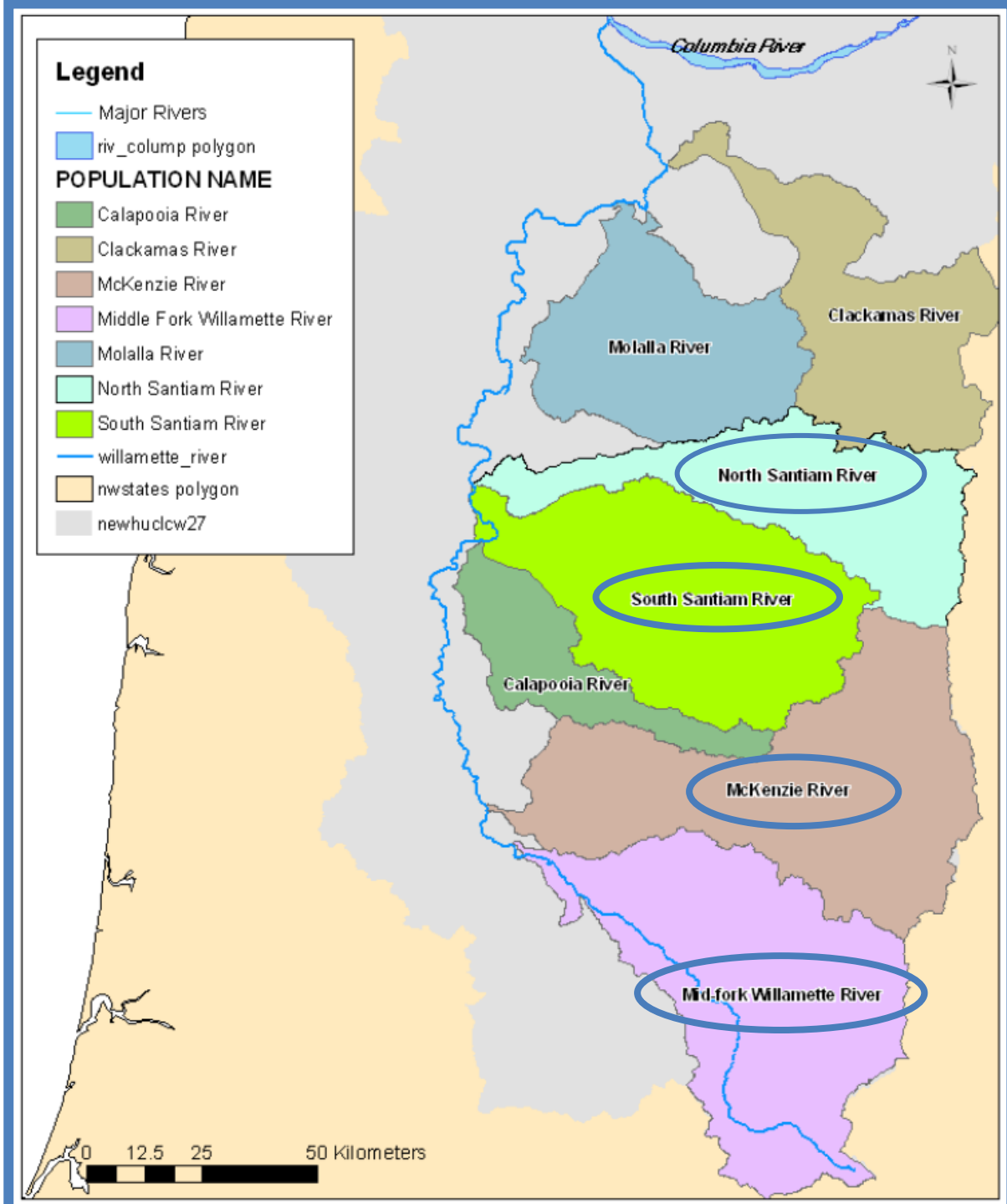
February 2015: ~6,000 Harbor Seals on Desdemona Sands, Near Astoria

February 2015: ~1,500 California Sea Lions at Astoria's East Mooring Basin

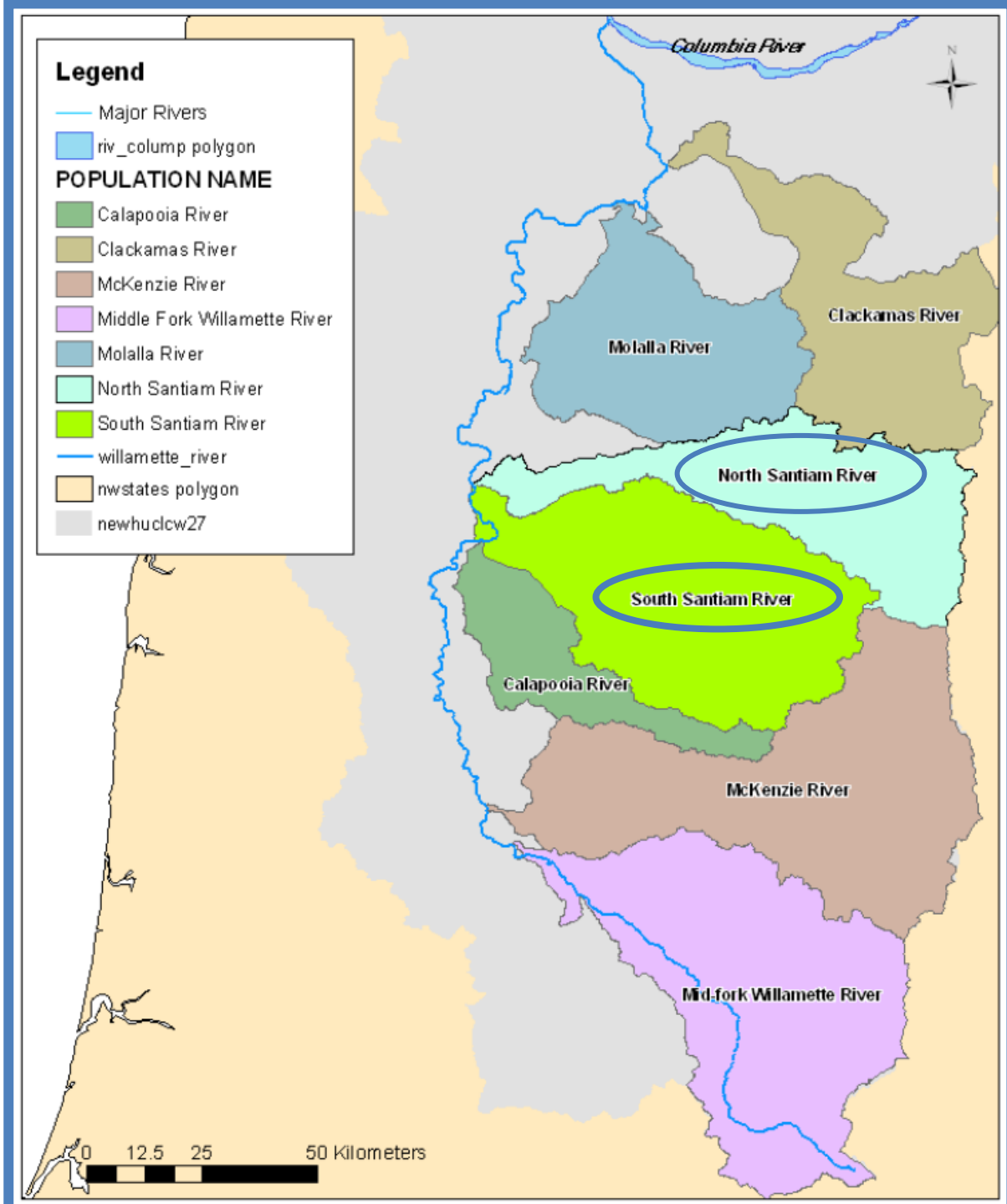
Upper Willamette River



Spring Chinook Population Models

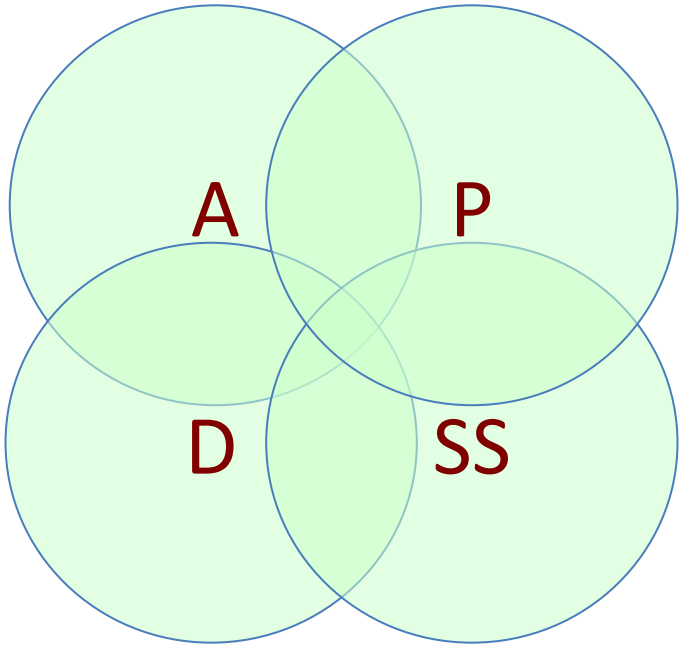


Winter Steelhead Population Models



VSP Categories

- Abundance
- Productivity
- Diversity
- Spatial Structure



- Population Score is a weighted average:
- Score = 4(Abundance&Productivity)
  +Diversity+Spatial Structure

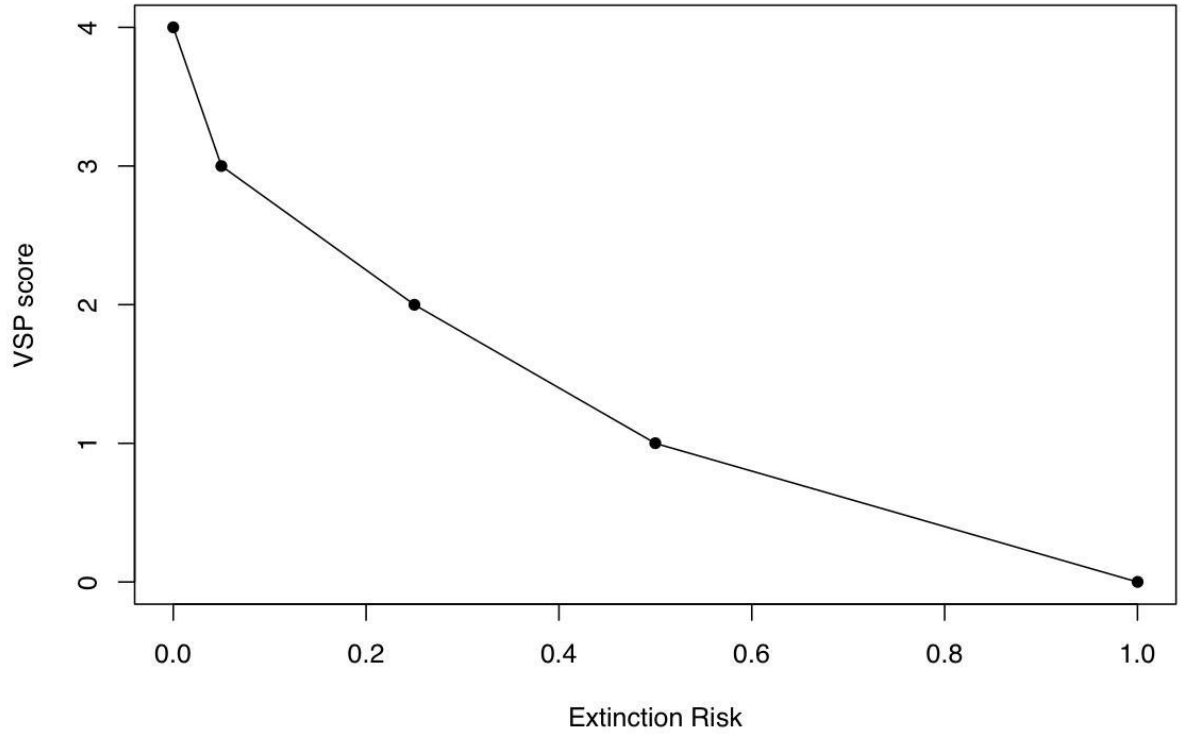
From McElhany et al 2000

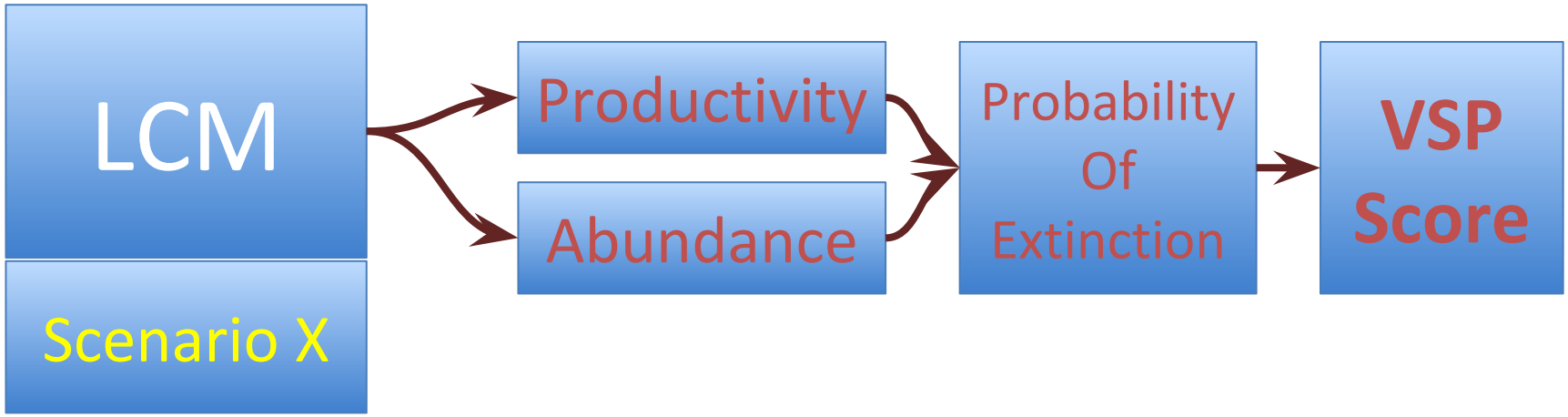
Higher Total VSP scores means – Properly functioning population

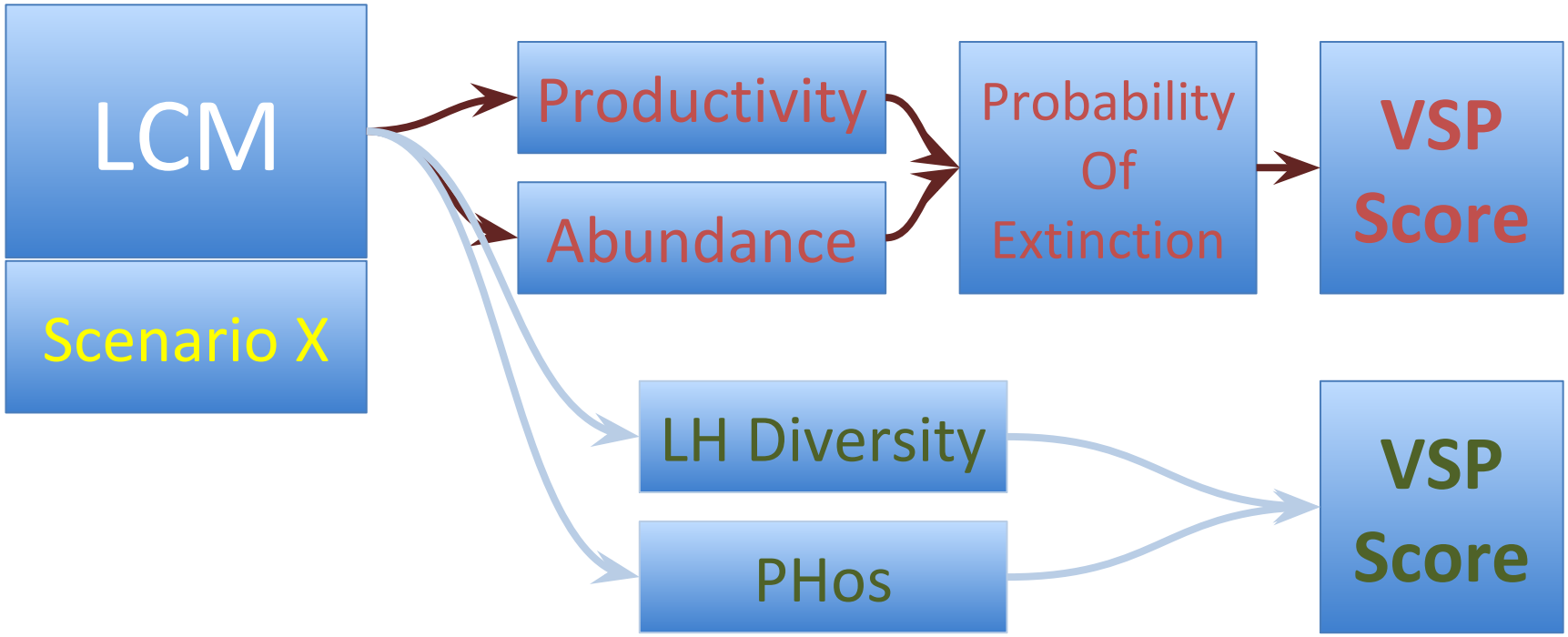
+ Life history diversity
+ Lower Hatchery influence
+ Greater utilization of diverse habitats
+ Greater resilience to stressors
  such as climate change

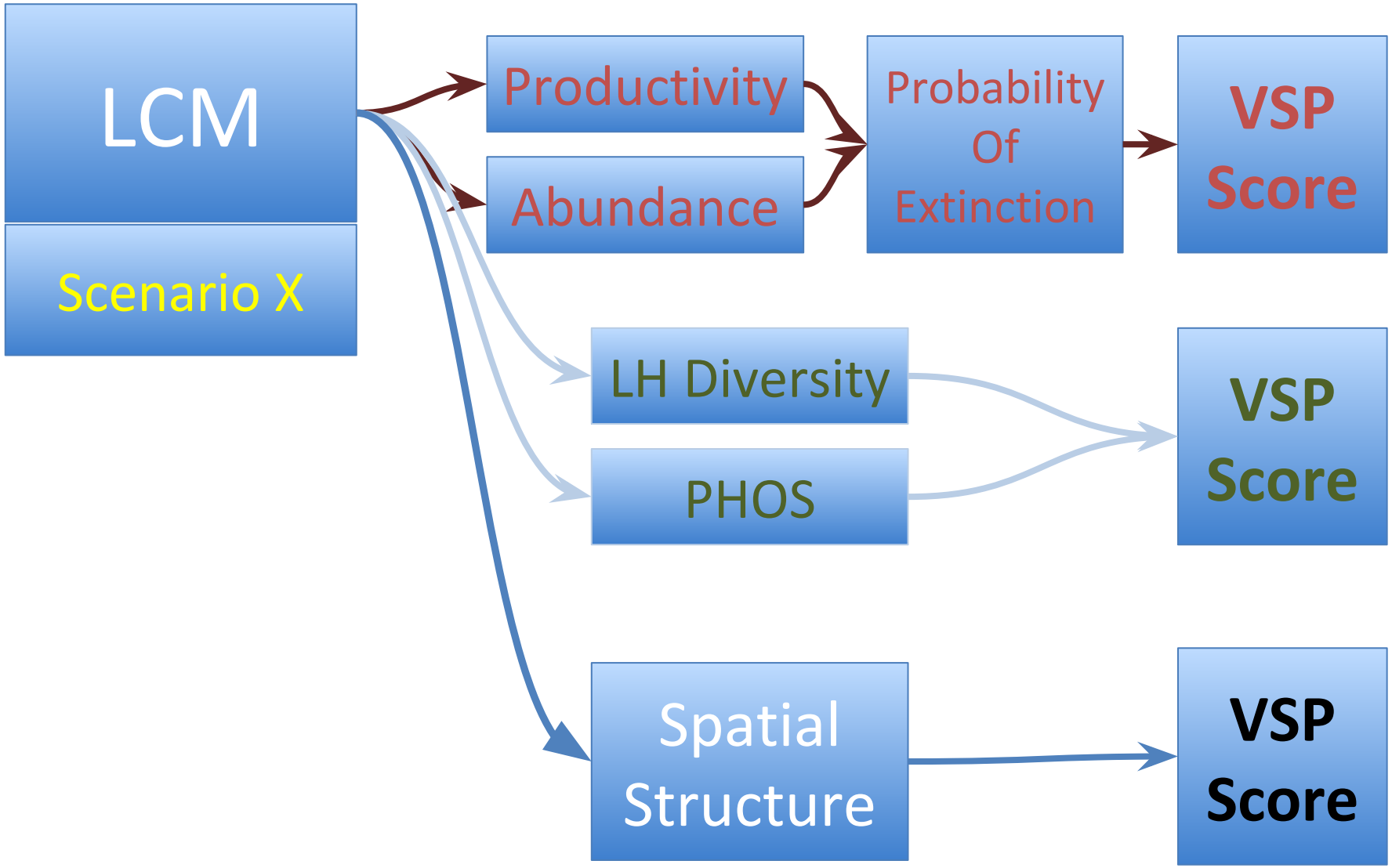
VSP Productivity and Abundance Scoring

Pop Persistence	P (persistence)	Description
0	0-40%	Very high risk
1	40-75%	High risk
2	75-95%	Moderate risk
3	95-99%	Viable
4	> 99%	Very low risk

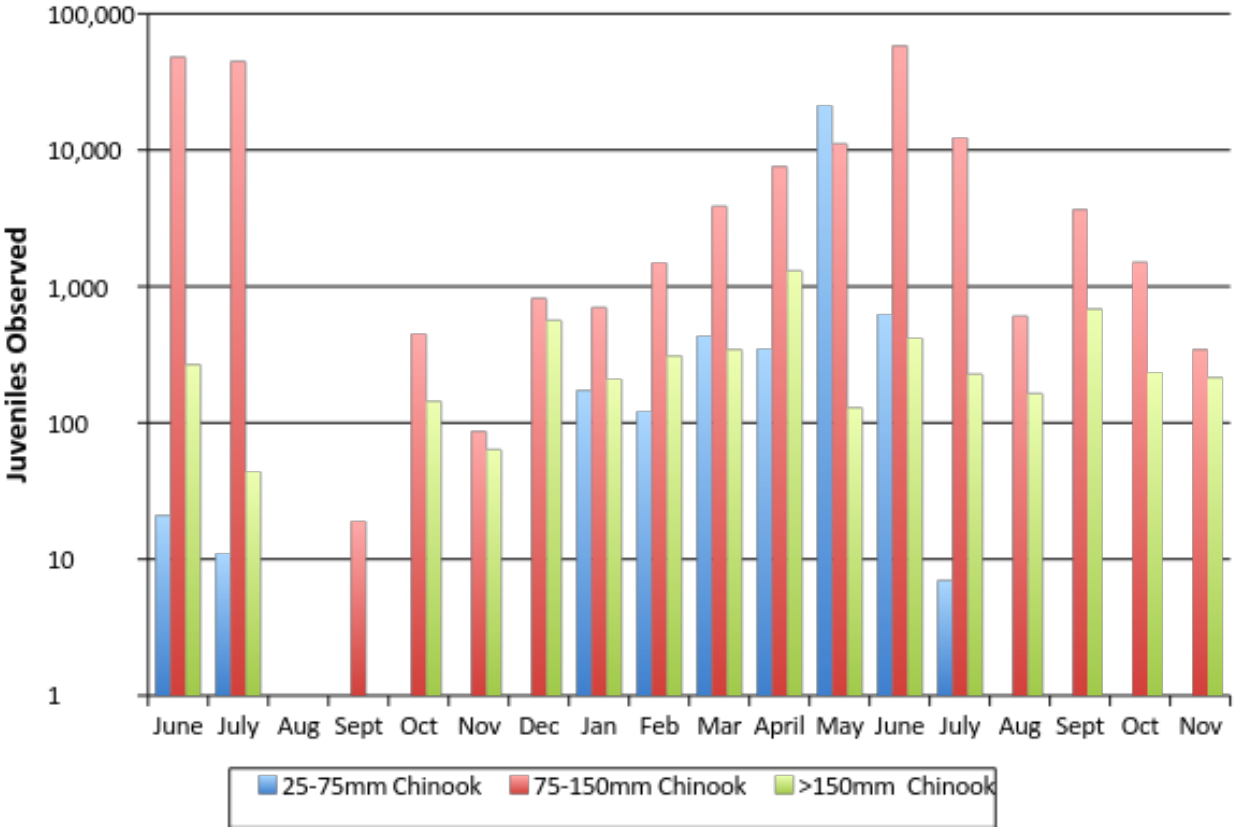



LCM
Scenario X
Productivity
Abundance
Probability Of Extinction
VSP Score

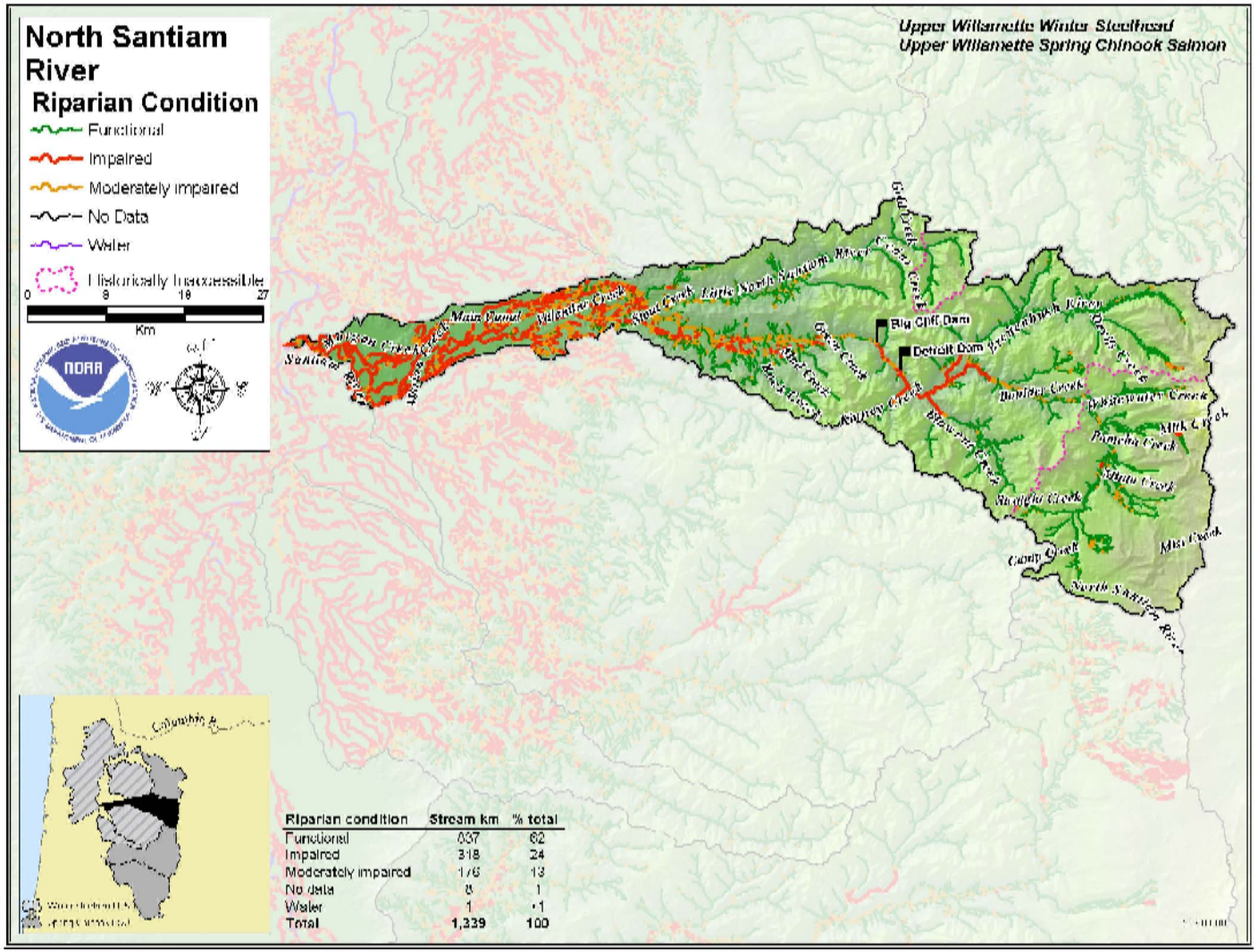

LCM
Scenario X
Productivity
Abundance
Probability Of Extinction
VSP Score
LH Diversity
PHos
VSP Score


LCM
Scenario X
Productivity
Abundance
Probability Of Extinction
VSP Score
LH Diversity
PHOS
VSP Score
Spatial Structure
VSP Score

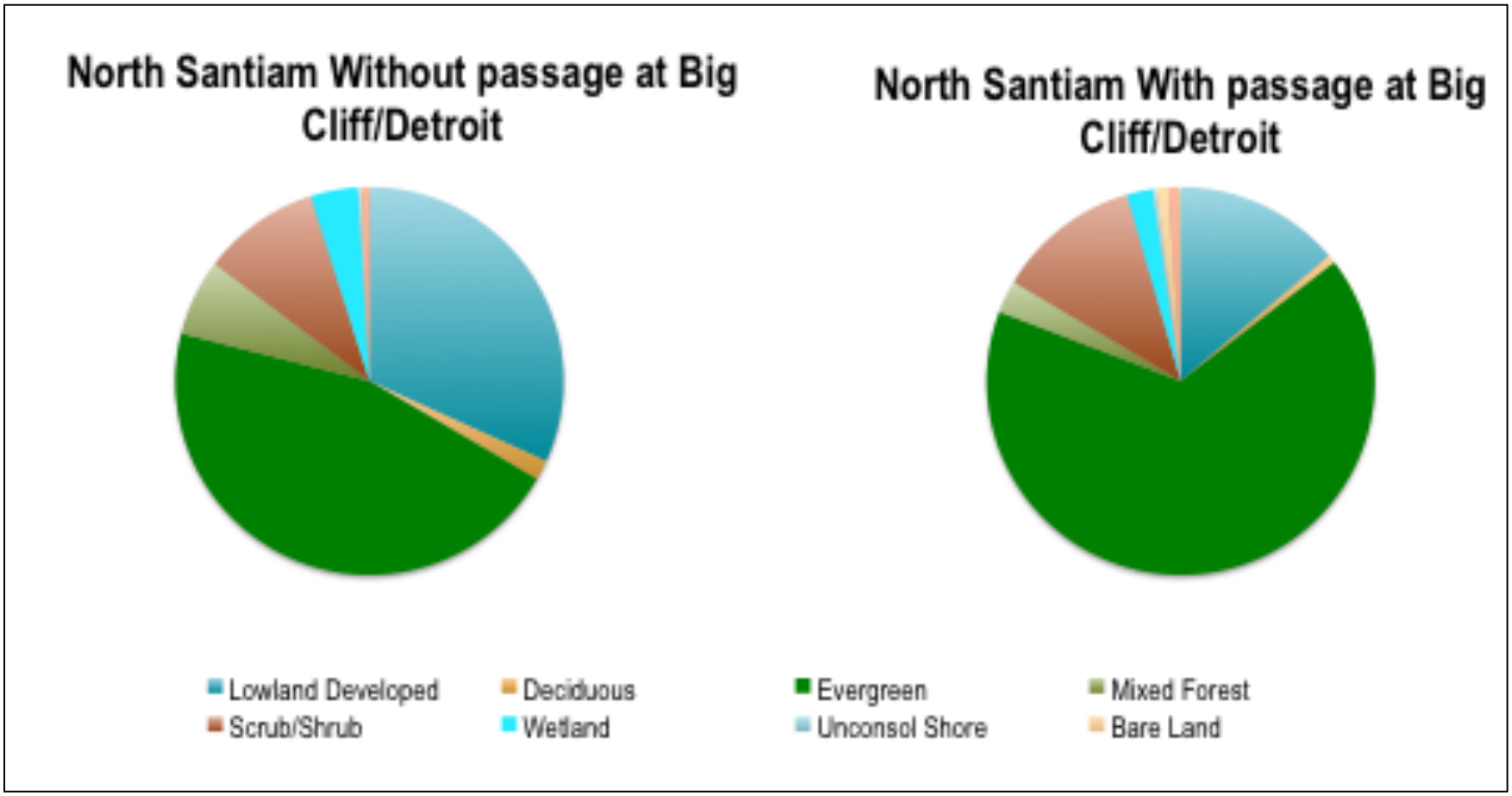
Size and time of passage for juvenile Chinook salmon at Willamette Falls 1965-1966



(Data from Massey 1967)



Maher, M., M.B. Sheer, E.A. Steel, and P. McElhany. 2005. Report for the Willamette-Lower Columbia Technical Recovery Team.



data from Sheer and Steel 2006

RESULTS: North Santiam Winter Steelhead